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DETERMINATION OF DEOXYGENATION CO-
EFFICIENTS, WILLAMETTE RIVER, SUMMER
1961

Public Health Service
Portland, Oregon

1961

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WORKING PAPER NO. 17

COLUMBIA RIVER BASIN PROJECT
For Water Supply and Water Quality Management

DETERMINATION OF DEOXYGENATION COEFFICIENTS

WILLAMETTE RIVER

SUMMER 1961

DISTRIBUTION

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U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
Public Health Service
Region IX

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Portland 5, Oregon

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This working paper contains preliminary data and information primarily intended for internal use by the Columbia River Basin Project staff and cooperating agencies. The material presented in this paper has not been fully evaluated and should not be considered as final.

DETERMINATION OF DEOXYGENATION COEFFICIENTS
AT CRITICAL LOCATIONS IN THE WILLAMETTE RIVER

INTRODUCTIONS

In determining the waste assimilative capacity of streams within the Willamette Basin, one of the primary considerations was determination of the deoxygenation coefficients (k_1) for critical locations within the basin. During the summer of 1961 two graduate sanitary engineering students from Oregon State University were employed principally to collect and analyze river samples for the determination of k_1 . Nine sampling stations were selected within the basin, seven on the main stem Willamette and two on tributary streams. These stations were located from river mile 7, near the mouth, to river mile 178 at Eugene.

SUMMARY

The deoxygenation coefficient (k_1 's) determined during the survey, were within the range that would be expected of the waters that were sampled. Changes in the rate of biochemical oxygen utilization were noted to vary with variations in the type and strength of the wastes that were being indirectly measured, and the relative quality of the waters being measured.

The background BOD of the Willamette River throughout the majority of its length is quite low. Conventional BOD time series of these waters would result in attempting to establish a rate for a very insignificant change in the total dissolved oxygen. In order to obtain the river k_1 , and resultant assimilative capacity, it was necessary to either obtain a sample of a characteristic waste and dilute this with river water from the area of waste discharge, or to obtain the sample from the river directly below a major waste source where a significant BOD would be present. A decision was made to sample the stream directly below the major waste source rather than the waste itself, and dilute it to a predetermined strength. It was felt this procedure would more closely approximate that which took place in the river under natural conditions.

It will be noted on the data sheets that a few of the river samples were diluted. This was done to maintain the ultimate BOD in the sample somewhere below 100 parts per million, which through experience, was found to be the best range with which to work.

LABORATORY METHOD UTILIZED

The method utilized in setting up the BOD time series was a modification of the reaeration technique used at the Robert A. Taft Sanitary Engineering Center in Cincinnati.

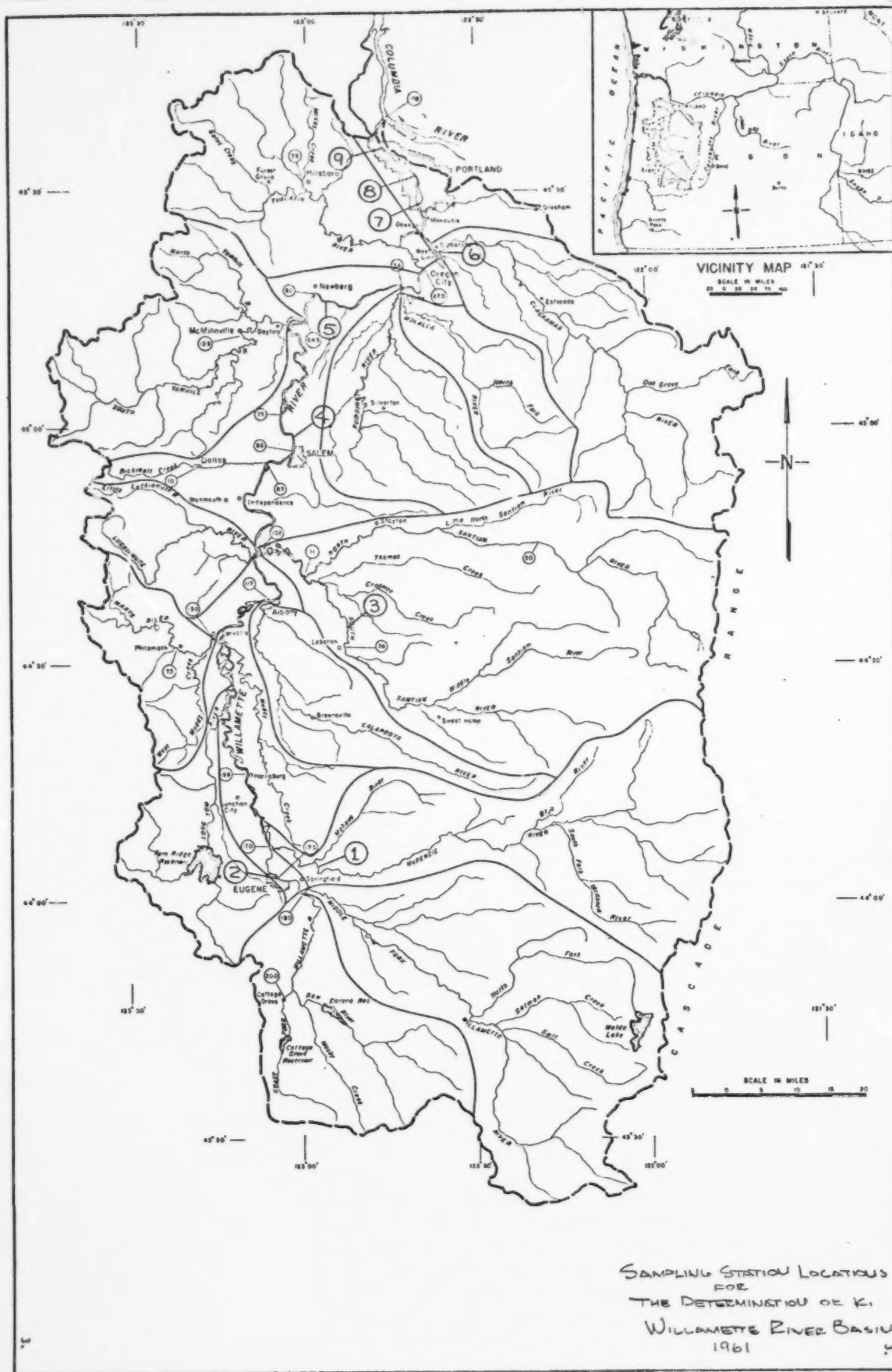
A three-gallon river sample was collected for each time series. The temperature of the sample at the time of collection was recorded

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and the sample was then transported to the laboratory. While in transit, attempts were made to maintain this sample at the initial river temperature. Samples were iced only when temperatures were extremely high. When the sample reached the laboratory, the temperature was again recorded. The maximum allowable time in transit between the time of collection and sample set-up, was three hours. 30 to 32 BOD bottles were then filled from the three-gallon sample. Two duplicate dissolved oxygen determinations were made immediately upon filling of the bottles and the remaining bottles were placed in a dark incubator and held at 20°C. Following this, two bottles were taken from the incubator and analyzed for dissolved oxygen at the end of 1, 2, 3, 4, 5, 7, 9, 11, 13, 15, and 20 days. If at the end of any given day it appeared that the remaining dissolved oxygen in the remaining samples would be depleted before the next set were analyzed, all remaining samples were then reaerated by emptying them into a large container and shaken until the dissolved oxygen was built up to six or seven parts per million. The bottles were then re-filled from the container and two were immediately analyzed for a new initial dissolved oxygen value and remaining bottles were again placed in the dark incubator.

SAMPLING STATIONS LOCATIONS

- No. 1: McKenzie River at R.M. 11.5 - directly below Weyerhaeuser-Springfield pulp and paper mill outfall.
- No. 2: The Willamette River at R.M. 178.0 - downstream from the City of Eugene's sewage treatment plant outfall, but above the confluence with the McKenzie.
- No. 3: South Santiam River near Lebanon at R.M. 27.0 and 18.3 - just downstream from the City of Lebanon's sewage treatment plant outfall, and the outfall from the Crown Zellerbach-Lebanon pulp and paper mill.
- No. 4: Willamette River near Salem at R.M. 82.0 - approximately one mile below the City of Salem's sewage treatment plant outfall and two and a half miles below the Oregon Pulp and Paper mill outfall.
- No. 5: Willamette River near Newberg at R.M. 48.0 - some two miles below the Newberg sewage treatment plant outfall and Spaulding Pulp and Paper Co. outfall.
- No. 6: Willamette River near Oregon City at R.M. 25.0 - one mile below Willamette Falls and Crown Zellerbach and Publisher Pulp and Paper companies.
- No. 7: Willamette River at Staff Jennings at R.M. 16.5 - in the upper Portland harbor.
- No. 8: Willamette River at the Steel Bridge at R.M. 12.0 - in Portland harbor.
- No. 9: Willamette River at the SP&S Railroad Bridge at R.M. 7.0 - in the lower Portland harbor.





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SAMPLING STATION LOCATIONS
FOR
THE DETERMINATION OF K_1
WILLAMETTE RIVER BASIN
1961

METHOD USED IN COMPUTING k_1 FROM BOD DATA (This method was developed by Dr. E. C. Tsivoglou at Robert A. Taft Sanitary Engineering Center in Cincinnati, Ohio.)

From the dissolved oxygen data obtained from each of the samples, BOD's were computed for each of the 1, 2, 3, etc., days. The BOD was computed for each of the duplicate DO's of each day and averaged if they were comparable. If the duplicate BOD's varied considerably, each value was plotted. The BOD was then plotted against time, in days, for the first stage of the BOD, usually to 10 days. (Figure 1) The plotted points were then fitted visually with a smooth curve of best fit. Following this, the BOD's were read from the fitted smooth curve at daily intervals and tabulated in the following example:

<u>STATION NO. 2</u>		
<u>9-11-61</u>		
<u>Days</u>	<u>BOD</u> <u>(Y)</u>	<u>Daily</u> <u>Differences</u> <u>(AY)</u>
0	--	
1	4.0	4.0
2	6.9	2.9
3	8.9	2.0
4	10.2	1.3
5	11.0	0.8
6	11.7	0.7
7	12.1	0.4

The daily differences in BOD were then obtained from this tabulation and plotted on semi-log paper against time in days, with differences on log scale, time on the linear scale (Figure 2). Extending the line through the points to $T=0$ gives a proportional value for the ultimate BOD (L) of 5.80. Therefore, with T equal to 6 days:

$$L_{T/L} = \frac{0.585}{5.80} \quad \text{fraction remaining} = 10.1\%$$

$$\text{From } L_{T/L} = 10^{KT} = \text{fraction remaining}$$

$$L_{T/L} \times 100 = 10^{KT} \times 10 = \text{percent remaining}$$

$$\text{Log of percent remaining} = \log (10^{KT} \times 10)$$

$$\text{Log percent BOD remaining} = 2 - k_1 t$$

If $t = 6$, % BOD remaining = 10.1, then

$$\text{Log } 10.1 = 2 - k_1 6$$

$$k_1 = \frac{2.0 - \log 10.1}{6}$$

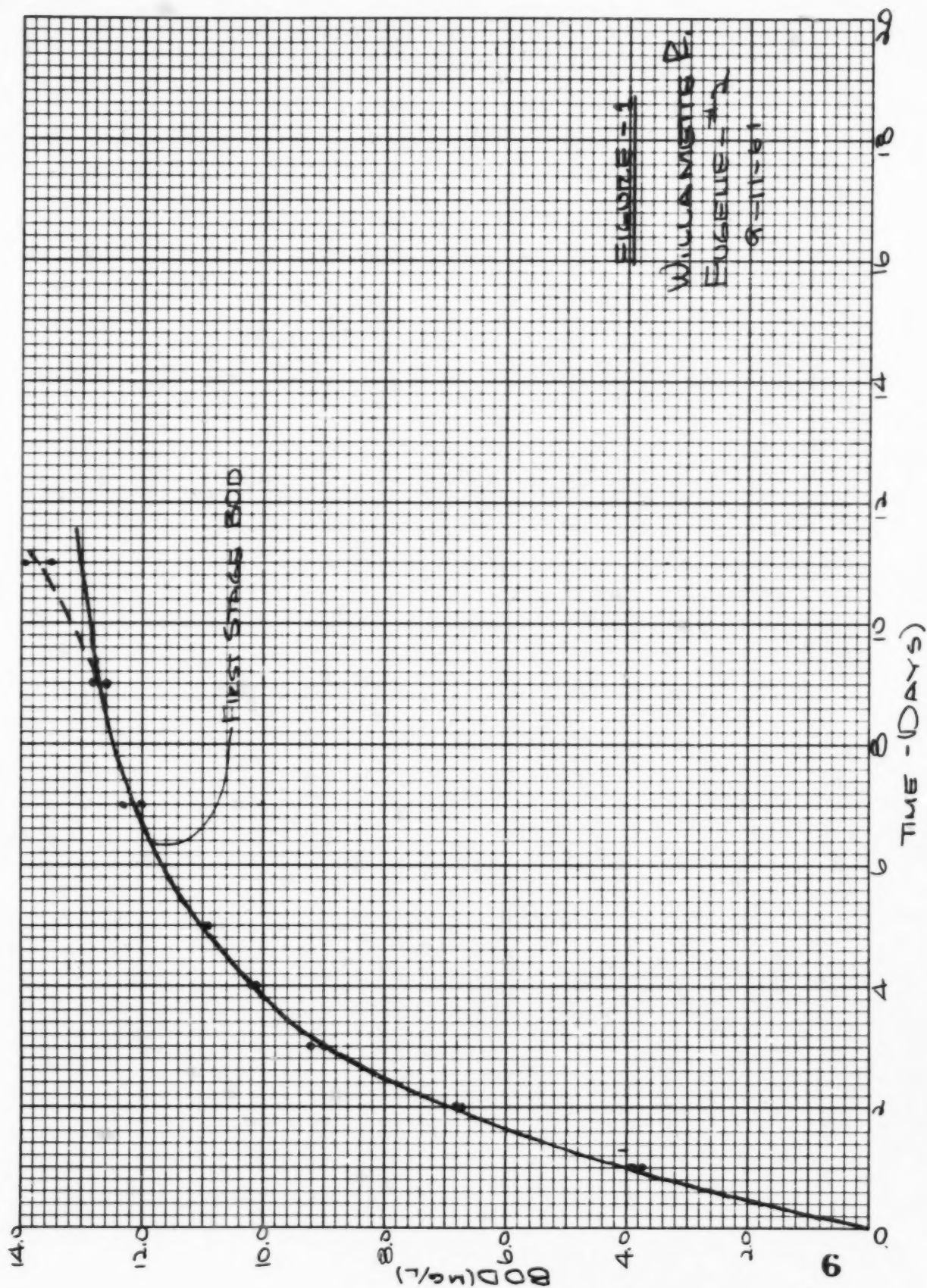
$$k = 0.166/\text{day}$$

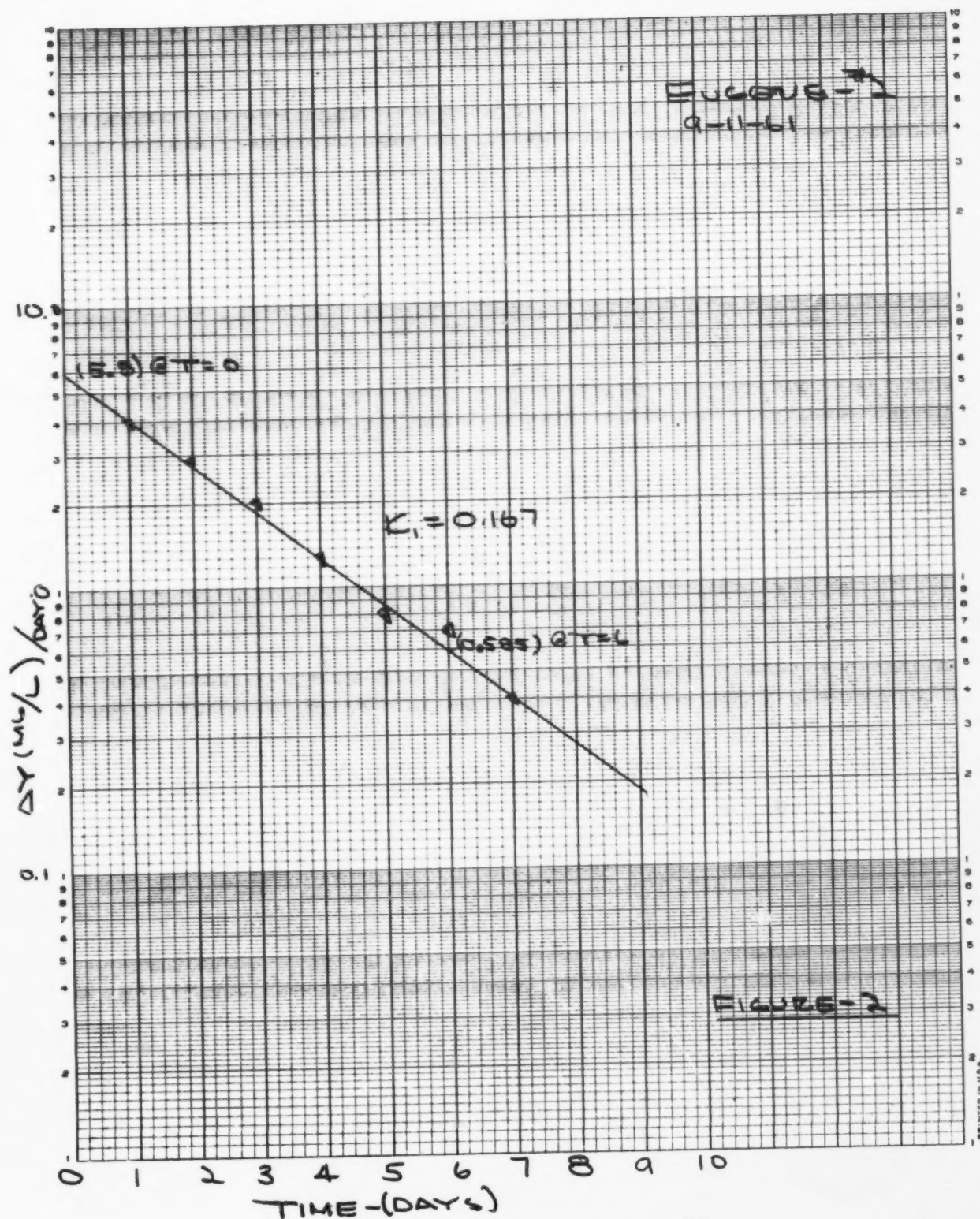
WILLAMETTE RIVER BASIN
 k_1 DETERMINATIONS - 1961

Station No.	Date								Average
	6-22	6-27	7-12	8-2	8-7	8-9	7-26	9-11	
1	0.175							0.134	0.154
2			0.130		0.0595**			0.167	0.148
3		0.163			0.118			*	0.140
4	0.187				0.140		0.168	0.148	0.160
5			0.139						0.139
6				0.160				0.157	0.158
7						0.117			0.117
8						0.123			0.123
9						0.0984			0.0984

* Sample taken on this date, but results erratic and not meaningful.

** Ultimate BOD (L_a) very low.





LONG TERM BOD DATA

WILLAMETTE RIVER - 1961

DATA SHEET - LONG TERM BOD'S

Station: No. 1 - McKenzie River

Date: 6-22-61

Crew: _____

Sampling Time: 9:10 a.m.

Temperature: 18° C.

Setup Time: 12:30 p.m.

Temperature: 21° C.

Day	Date	Time	DO (ppm)		DO (ppm) (Average)	BOD (ppm)
			No. 1	No. 2		
Initial	6-22		8.5	8.7	8.6	
1	6-23		3.2	2.8	3.0	5.6
* 2	reaerated 6-24		6.5 3.8	6.5 3.9	6.5 3.85	8.25
3	6-25		2.3	2.1	2.2	9.9
4	6-26		0.8	0.8	0.8	11.3
* 5	reaerated 6-27		7.8 6.3	7.7 6.4	7.75 6.35	12.7
6						
7	6-29		4.75	5.0	4.87	14.15
9	7-1		4.25	1.8	3.02	16.0
11	7-3		2.27	1.21	1.74	17.3
13	7-5		1.70			
15						
20	7-12		0.3	0.3	0.3	18.9

Comments:

$K_1 = 0.175/\text{day}$

DATA SHEET - LONG TERM BOD'S

Station: No. 1 - McKenzie River

Date: 9-11-61

Crew: _____

Sampling Time: 3:15 p.m.

Temperature: 21.5° C.

Setup Time: 5:45 p.m.

Temperature: 23° C.

Day	Date	Time	DO (ppm)		DO (ppm) (Average)	BOD (ppm)
			No. 1	No. 2		
Initial	9-11		7.9	8.1	8.0	
1	9-12		4.6	4.7	4.7	3.4
2	9-13		3.5	3.5	3.5	4.5
3	9-14		1.1	1.0	1.1	7.0
4	reaerated 9-15		6.4 2.9	6.2 3.1	6.3 3.0	10.3
5	reaerated 9-16		7.5 5.2	7.6 5.2	7.6 5.2	12.6
6						
7	9-18		3.6	3.6	3.6	14.2
9	9-20		2.1 7.2	1.7	1.9 7.0	15.9
11	9-22		5.2	5.0	5.1	17.9
13	9-24					
15	9-26		3.7	3.7	3.7	19.4
20	10-1					
21	10-2		1.5	1.8	1.65	21.45

Comments:

$K_1 = 0.134/\text{day}$

bottom tray north

DATA SHEET - LONG TERM BOD'S

Station: No. 2 - Willamette River

Date: 7-12-61

Crew: _____

Sampling Time: 4:30 p.m.

Temperature: 19.5° C.

Setup Time: 5:30 p.m.

Temperature: 24.5° C.

Day	Date	Time	DO (ppm)		DO (ppm) (Average)	BOD (ppm)
			No. 1	No. 2		
Initial	7-12		8.7	8.9	8.8	
1	7-13		7.9	8.1	8.0	0.8
2	7-14		7.4	7.3	7.35	1.45
3	7-15		6.5	6.5	6.5	2.3
4	7-16		6.2	6.0	6.0	2.7
5	7-17		5.7	- -	5.7	3.0
6						
7	7-19		5.1	5.4	5.25	3.55
9	7-21		4.9	4.9	4.9	3.9
11	7-23		4.1	4.2	4.15	4.65
13	7-25		4.2	3.6	3.9	4.9
15	7-27		3.8	3.9	3.85	4.95
20	8-1		3.1	3.1	3.1	5.7

Comments:

$K_1 = 0.130/\text{day}$

DATA SHEET - LONG TERM BOD'S

Station: No. 2 - Willamette River

Date: 8-7-61

Crew: _____

Sampling Time: 10:55 a.m.

Temperature: 16° C.

Setup Time: 1:30 p.m.

Temperature: 18° C.

Day	Date	Time	DO (ppm)		DO (ppm) (Average)	BOD (ppm)
			No. 1	No. 2		
Initial	8-7		9.1	9.3	9.2	0.1
1	8-8		8.9	9.3	9.1	0.2
2	8-9		8.8	8.9	8.9	0.5
3	8-10		8.6	8.7	8.7	0.7
4	8-11					
5	8-12		8.3	8.2	8.2	1.1
6						
7	8-14		7.9	7.7	7.8	1.5
9	8-16		7.8	7.8	7.8	
11	8-18		7.6	7.6	7.6	1.7
13	8-20		7.0	7.0	7.0	2.3
15	8-22		7.1	7.0	7.0	2.3
20	8-27		7.0	6.9	7.0	2.4

Comments:

DO's taken at 1:15 p.m.
No dilution.
 $K_1 = 0.0595/\text{day}$

DATA SHEET - LONG TERM BOD'S

Station: No. 2 - Willamette River

Date: 9-11-61

Crew: _____

Sampling Time: 3:45 p.m.

Temperature: 19°C.

Setup Time: 5:50 p.m.

Temperature: 20°C.

Day	Date	Time	DO (ppm)		DO (ppm) (Average)	BOD (ppm)
			No. 1	No. 2		
Initial	9-11		9.4	9.4	9.4	
1	9-12		5.7	5.5	5.6	3.8
2	9-13		2.7	2.6	2.7	6.8
3	reaerated 9-14		7.9 5.6	7.9 5.5	7.9 5.6	9.1
4	9-15		4.4	4.6	4.5	10.2
5	9-16		3.6	3.6	3.6	11.0
6						
7	9-18		2.6	2.4	2.5	12.2
9	9-20		2.0 8.1	1.9 8.1	2.0 8.1	12.7
11	9-22		7.2	7.0	7.1	13.7
13						
15	9-26		5.3	5.1	5.2	15.6
20						
21	10-2		3.4	3.3	3.4	17.5

Comments:

Middle tray north

$K_1 = 0.167/\text{day}$

DATA SHEET - LONG TERM BOD'S

Station: No. 3 - South Santiam River

Date: 6-27-61

Crew: _____

Sampling Time: 12:15 p.m.

Temperature: 21° C.

Setup Time: 1:40 p.m.

Temperature: 21° C.

Day	Date	Time	DO (ppm)		DO (ppm) (Average)	BOD (ppm)
			No. 1	No. 2		
Initial	6-27		7.9	8.0	7.95	
1	6-28		5.04	5.04	5.04	28.9
2	6-29		2.90	3.0	2.95	49.8
3	6-30		1.77	1.92	1.84	60.8
4	re-aerated 7-1		7.38 6.31	7.09 6.31	7.23 6.31	70.0
5	7-2		5.74	5.45	5.59	77.2
6						
7	7-4		4.83	4.86	4.84	84.7
9	7-6		4.53	4.46	4.49	88.2
11	7-8		3.33	3.05	3.19	101.2
13	7-10		1.56	1.50	1.53	117.8
15	7-12		0.20	0.20	0.20	133.0
20	7-17					

Comments:

1 in 10 dilution

$K_1 = 0.163/\text{day}$

DATA SHEET - LONG TERM BOD'S

Station: No. 3 - Santiam River

Date: 8-7-61

Crew: _____

Sampling Time: 12:25 p.m.

Temperature: 22° C.

Setup Time: 1:45 p.m.

Temperature: 23° C.

Day	Date	Time	DO (ppm)		DO (ppm) (Average)	BOD (ppm)
			No. 1	No. 2		
Initial	8-7		5.8 6.5	5.7 6.6	5.8 6.6	
1	8-8		6.3	6.4	6.4	0.2
2	8-9		5.8	5.9	5.9	0.7
3	8-10		5.0	5.3	5.2	1.4
4	8-11					
5	8-12		3.7	3.8	3.8	2.8
6						
7	8-14		3.0	2.8	2.9	3.7
9	8-16	Reaerated	8.0 2.5	7.9 2.4	8.0 2.5	4.1
11	8-18		6.9	6.8	6.9	5.2
13	8-20		6.2	6.1	6.2	5.9
15	8-22		6.1	6.3	6.2	5.9
20	8-27		5.6	5.6	5.6	6.5

Comments:

DO's taken at 1:15 p.m. DST

No dilution.

Sample was taken at bridge near Crabtree.

$K_1 = 0.118/\text{day}$

DATA SHEET - LONG TERM BOD'S

Station: No. 3 - Santiam River

Date: 9-11-61

Crew: _____

Sampling Time: 4:55 p.m.

Temperature: 21° C.

Setup Time: 5:50 p.m.

Temperature: 21.5° C.

Day	Date	Time	DO (ppm)		DO (ppm) (Average)	BOD (ppm)
			No. 1	No. 2		
Initial	9-11		8.8	8.8	8.8	
1	9-12		8.5	8.7	8.6	0.2
2	9-13		8.2	8.2	8.2	0.6
3	9-14		7.8	7.8	7.8	1.0
4	9-15		7.3	7.4	7.4	1.5
5	9-16		6.5	6.4	6.5	2.4
6						
7	9-18		6.0	5.8	5.9	2.9
9	9-20		4.9	4.9	4.9	3.9
11	9-22		4.1	4.3	4.2	4.6
13	9-24					
15	9-26		3.1	3.3	3.2	5.6
20						

21 10.2 2.8 2.7 2.8 6.1

Comments:

3/4(X) = 1st days readings.

1st day BOD actually = 2.7.

Top tray north.

K₁ = Sample taken, but results erratic and not meaningful.

DATA SHEET - LONG TERM BOD'S

Station: No. 4 - Willamette River

Date: 7-26-61

Crew: _____

Sampling Time: 11:00 a.m.

Temperature: 21° C.

Setup Time: 1:30 p.m.

Temperature: 22° C.

Day	Date	Time	DO (ppm)		DO (ppm) (Average)	BOD (ppm)
			No. 1	No. 2		
Initial	7-26		8.6	8.3	8.5	
1	7-27		7.7	7.4	7.6	9
2	7-28		7.8	7.4	7.6	9
3	7-29		6.9	6.8	6.9	16
4	7-30		6.5	6.5	6.5	20
5	7-31		6.5	6.3	6.4	21
6						
7	8-2		6.3	6.2	6.3	22
9	8-4		5.9	5.6	5.8	27
11	8-6		5.3	5.2	5.3	32
13	8-8		4.9	4.8	4.9	36
15	8-10		5.1	4.8	5.0	35
20	8-15		4.4	4.3	4.4	41

Comments:

DO's taken at 1:15 p.m.
Dilution factor - 1 in 10
 $K_1 = 0.168/\text{day}$

DATA SHEET - LONG TERM BOD'S

Station: No. 4 - Willamette River

Date: 6-22-61

Crew: _____

Sampling Time: 4:30 p.m.

Temperature: 20.5° C.

Setup Time: 5:40 p.m.

Temperature: 22.5° C.

Day	Date	Time	DO (ppm)		DO (ppm) (Average)	BOD (ppm)
			No. 1	No. 2		
Initial	6-22		7.1	7.2	7.15	
1	6-23		2.9	2.8	2.85	4.3
2	reaerated 6-24		7.5 3.2	7.4 3.9	7.45 3.55	8.2
3	6-25		2.4	2.1	2.25	9.5
4	6-26		1.3	1.5	1.40	10.35
5	reaerated 6-27		7.8 6.3	7.7 5.70	7.75 6.00	12.1
6						
7	6-29		4.9	5.1	5.0	13.1
9	7-1		3.2	2.9	3.05	16.05
11	7-3		0.5	0.5	0.5	17.6
13	reaerated 7-5		7.04 2.9	7.65 2.9	7.34 2.9	22.0
15	7-7					
20	7-12		1.1	0.6	0.85	24.05

Comments:

$K_1 = 0.187/\text{day}$

DATA SHEET - LONG TERM BOD'S

Station: No. 5 - Willamette River

Date: 7-12-61

Crew: _____

Sampling Time: 10:50 a.m.

Temperature: 24° C.

Setup Time: 1:50 p.m.

Temperature: 26.5° C.

Day	Date	Time	DO (ppm)		DO (ppm) (Average)	BOD (ppm)
			No. 1	No. 2		
Initial	7-12		7.8	8.0	7.9	
1	7-13		7.0	7.1	7.05	4.0
2	7-14		6.5	6.6	6.55	6.5
3	7-15		6.4	6.4	6.4	7.25
4	7-16		6.0	6.2	6.1	8.75
5	7-17		5.5	5.7	5.6	11.25
6						
7	7-19		5.4	5.5	5.45	12.0
9	7-21		5.4	5.4	5.4	12.25
11	7-23		5.0	4.9	4.95	14.5
13	7-25		4.5	4.9	4.7	15.5
15	7-27		4.4	4.4	4.4	17.0
20	8-1		3.8	4.0	3.9	19.5

Comments:

Dilution factor - 1 in 5

$K_1 = 0.139/\text{day}$

DATA SHEET - LONG TERM BOD'S

Station: No. 6 - Willamette River

Date: 8-2-61

Crew: _____

Sampling Time: 2:30 p.m.

Temperature: _____

Setup Time: 4:40 p.m.

Temperature: 24.5° C.

Day	Date	Time	DO (ppm)		DO (ppm) (Average)	BOD (ppm)
			No. 1	No. 2		
Initial	8-2-61		7.5	7.5	7.5	
1	8-3		5.7	5.6	5.5	1.8
2	8-4		4.8	4.8	4.8	2.7
3	8-5		4.0	4.2	4.1	3.4
4	8-6		2.6	3.3	3.0	4.6
5	8-7		2.9	2.9	2.9	4.6
6						
7	8-9		2.9	2.6	2.8	4.8
9	re-aerated 8-11		2.1 8.2	2.1 8.3	2.1 8.3	5.4
11	8-13		7.2	7.2	7.2	6.5
13	8-15		7.1	7.4	7.3	6.4
15	8-17		6.4	6.5	6.5	7.2
20	8-22		5.7	5.8	5.8	7.9

Comments:

DO's taken at 1:15 p.m.
No dilution.
 $K_1 = 0.160/\text{day}$

DATA SHEET - LONG TERM BOD'S

Station: No. 6 - Willamette River

Date: 9-11-61

Crew: _____

Sampling Time: 10:10 a.m.

Temperature: 18.5° C.

Setup Time: 12:50 p.m.

Temperature: 19.0° C.

Day	Date	Time	DO (ppm)		DO (ppm) (Average)	BOD (ppm)
			No. 1	No. 2		
Initial	9-11		8.2	8.2	8.2	
1	9-12		7.2	7.3	7.3	1.0
2	9-13		6.3	6.1	6.2	2.0
3	9-14		5.5	5.4	5.5	2.8
4	9-15		5.2	5.0	5.1	3.1
5	9-16		4.8	4.4	4.6	3.6
6						
7	9-18		4.6	4.5	4.6	3.7
9	9-20		4.1	4.1	4.1	4.1
11	9-22		3.8	3.9	3.9	4.3
13	9-24					
15	9-26		3.2	3.4	3.3	4.9
20	10-2		2.4	2.5	2.5	5.8

Comments:

$K_1 = 0.157/\text{day}$

DATA SHEET - LONG TERM BOD'S

Station: No. 7 - Willamette River

Date: 8-9-61

Crew: _____

Sampling Time: 2:30 p.m.

Temperature: _____

Setup Time: 4:50 p.m.

Temperature: 24° C.

Day	Date	Time	DO (ppm)		DO (ppm) (Average)	BCD (ppm)
			No. 1	No. 2		
Initial	8-9		7.94	7.94	7.94	
1	8-10		7.52	7.43	7.48	0.47
2	8-11		7.23	7.17	7.20	0.74
3	8-12		6.75	6.80	6.78	1.17
4	8-13		6.45	6.60	6.53	1.42
5	8-14		6.33	6.35	6.34	1.60
6						
7	8-16		6.16	6.04	6.10	1.84
9	8-18		5.82	5.68	5.75	2.19
11	8-20		5.85	5.70	5.78	2.17
13	8-22		5.13	5.06	5.10	2.85
15	8-24		4.60	5.10	4.85	3.09
20	8-29		3.45	3.15	3.30	4.64

Comments:

$K_1 = 0.117/ \text{ day}$

DATA SHEET - LONG TERM BOD'S

Station: No. 8 - Willamette River

Date: 8-9-61

Crew: _____

Sampling Time: 2:00 p.m.

Temperature: _____

Setup Time: 4:30 p.m.

Temperature: 24° C.

Day	Date	Time	DO (ppm)		DO (ppm) (Average)	BOD (ppm)
			No. 1	No. 2		
Initial	8-9		7.85	7.78	7.82	
1	8-10		7.13	7.15	7.14	0.68
2	8-11		6.75	6.65	6.70	1.12
3	8-12		6.11	6.39	6.25	1.55
4	8-13		5.88	5.97	5.93	1.88
5	8-14		5.73	5.74	5.74	2.08
6						
7	8-16		5.25	5.48	5.37	2.45
9	8-18		4.98	5.08	5.03	2.79
11	8-20		4.87	5.00	5.07	2.28
13	8-22		4.60	4.57	4.59	3.23
15	8-24		3.92	3.75	3.84	4.03
20	8-29		2.72	1.93	2.33	5.49

Comments:

$K_1 = 0.123/\text{day}$

DATA SHEET - LONG TERM BOD'S

Station: No. 9 - Willamette River

Date: 8-9-61

Crew: _____

Sampling Time: 1:30 p.m.

Temperature: _____

Setup Time: 4:20 p.m.

Temperature: 24° C.

Day	Date	Time	DO (ppm)		DO (ppm) (Average)	BOD (ppm)
			No. 1	No. 2		
Initial	8-9		6.97	7.13	7.05	
1	8-10		6.62	6.50	6.56	0.49
2	8-11		6.12	6.23	6.18	0.87
3	8-12		5.91	5.84	5.88	1.17
4	8-13		5.37	5.55	5.46	1.59
5	8-14		5.58	5.17	5.38	1.67
6						
7	8-16		4.23	4.15	4.19	1.86
9	8-18		4.87	4.97	4.92	
11	8-20		3.83	4.20	4.01	2.04
13	8-22		3.90	3.45	3.68	2.37
15	8-24		3.28	3.40	3.34	2.71
20	8-29		2.05	1.95	2.00	4.05

Comments:

$K_1 = 0.0984/\text{day}$